PHYTOTOXICOLOGY SECTION
INVESTIGATION OF THE DECOMMISSIONING OF HOLMES FOUNDRY, 220 EXMOUTH ST., SARNIA

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1 Background

Holmes Foundry, 220 Exmouth St., Sarnia was an automotive parts manufacturer owned by Chrysler Canada Ltd. The plant was closed down in 1988 and the property sold to a developer. Site decommissioning was being carried out by MacLaren Engineers Inc. on contract to Chrysler Canada Ltd. before the property was to be turned over to the new owner.

George Zsober of the Sarnia, MOE office requested that the Phytotoxicology Section, Air Resources Branch collect soil samples from three locations on the property as a Ministry audit of the contractor. On May 10, 1989 Randall Jones and Dave McLaughlin of the Phytotoxicology Section with George Zsober met with Mr. Lonnie Luciw of MacLaren Engineers on the Holmes Foundry property. It was agreed that two trenches would be dug by the contractors adjacent to two sites already sampled by the contractor. The sites chosen were Bore Hole No. 6, an area where foundry sand had been stored and that tests had indicated no soil removal was required, and Trench #220, a site where sampling had indicated that soil be removed to a depth of one meter due to elevated heavy metal levels.

The sampling was carried out that same morning. Samples were collected for both organic and inorganic analysis.

2 Methods

Two sampling trenches were excavated by MacLaren personnel using a back hoe. The first trench was located approximately two meters north of Bore Hole No. 6 as shown on MacLaren Tech Inc. drawing no. 52860-31 rev. F "Soil Removal Program Plan of Excavations, Chrysler Canada Ltd., Holmes Foundry". The trench was approximately 1.3 meters deep, 2 meters wide and 3 meters long. The trench ran in a north-south direction with the north end sloping at a 45 degree angle. There was 20 to 30 cm of water in the bottom of the trench. The second trench was located near sampling trench TR 220 as shown on MacLaren Tech Inc. drawing no. 52860-31 rev. F "Soil Removal Program Plan of Excavations, Chrysler Canada Ltd., Holmes Foundry". The trench was 8.5 meters west of the tunnel wall and 40 m north of the butler building, measured to the middle of the trench face that was sampled. This trench was 1.3 meters deep, 2 meters wide and 3 meters long. It also ran in a north-south direction. There was no water at the bottom of the second trench.

At the sampling trench near Bore Hole No. 6 samples were taken at 0-5 cm, 10-15 cm, 25-30 cm and 85-100 cm depths using an Oakfield soil sampler. Separate samplers were used for the organic and inorganic samples. The sampler was washed in Alconox detergent and rinsed with distilled water between the collection of samples at each depth. The 0-5 cm samples were collected within 0.25 meters of the west and south sides of the trench using the normal sampling procedures. The samples for the 10-15 cm, 25-30 cm and 85-100 cm depths were taken from the trench face on the south and west sides of the trench. Before sampling, the trench face was cut back with a clean shovel to remove any cross contamination introduced by the back hoe. At each depth, ten cores 10 cm long were taken by inserting the sampler into the soil at right angles to the trench face. At the

85-100 cm depth, sampling was complicated by a thick layer of course grey fibrous material that restricted sampling to a few centimeters above and below this material. During sampling some of this material was also collected.

At the sampling trench near trench TR 220 samples were taken at 0-5 cm, 10-15 cm, 25-30 cm, 85-100 cm and 120-130 cm depths. Because of the amount of rock and other debris in the soil at this site, the Oakfield soil sampler could not be used. Instead a narrow blade (10 cm wide) shovel was used to collect the samples. The shovel was inserted 5 to 10 cm into the side of the trench at the appropriate depth. Five small shovels-full were collected at each depth. The shovel was washed in Alconox detergent and rinsed with distilled water between the collection of samples at each depth. The samples were collected from the south and west faces of the trench after the face was cut back with a shovel.

A surface sample 0 - 5 cm of soil from an atrium were oil cooled transformers had been located was also collected for organic analysis.

All samples were locked in the Ministry vehicle immediately after being sampled and were sealed with legal seals upon return to the Brampton Controlled Environment Laboratory. The samples were delivered to the Phytotoxicology Sampling Processing Laboratory. The inorganic samples were air dried and sieved before being submitted to the Laboratory Services Branch, Inorganic Trace Contaminants Section for analysis for antimony, arsenic, barium, beryllium, cadmium chromium, cobalt, copper, lead, magnesium, manganese, mercury, molybdenum, nickel, nitrogen, selenium, silver, sulphur, vanadium, and zinc.

The organic samples were stored in a refrigerator until they were delivered to the Trace Organic Section, Laboratory Services Branch for analysis. The samples were treated as solid samples and extracts were analysed for PAHs (pentachlorobenzene, hexachlorobenzene, octachlorostryrene, napthalene, 2-methylnaphtalene, 1-methylnaphtalene, phenanthrene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, perylene, benzo(k)fluoranthene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibnezp(a,h)anthracene, benzo(g,h,i)perylene), PCBs as Aroclor 1254 and chloroform extractables. In addition the following volatile compounds were analysed for using headspace / capillary gas chromatography: methylene chloride, trans-1,2-dichloroethylene, 1,1-dichloroethane, chloroform, 1,1,1-trichloroethane, benzene, carbon tetrachloride, bromodichloromethane, trichloroethylene, 1,2-dichloropropane, toluene, 1,1,2-trichloroethane, tetrachloroethylene, chlorodibromomethane, chlorobenzene, ethylbenzene, bromoform, m/p-xylene, 0-xylene, 1,1,2,2-tetrachlorethane, 1,4-dichlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, napthalene and medium boiling point petrolium distilate type materials.

3 Results

The soil at Bore Hole No. 6 consisted largely of black foundry sand mixed with some clay and lots of debris. The debris consisted of rocks, small pieces of concrete and pieces of metal. As well as the debris there was a layer of grey course fibrous material approximately 8 to 10 cm thick in the 85-100 cm depth region. The grey fibrous material was identified by MOE Laboratory to be

what is commonly called rock wool. The soil at this location to the depth of 1.3 m appears to have consisted entirely of fill material. What could be considered as native soil was not observed in this pit.

The soil at the location TR 220 was totally different from that near Bore Hole No. 6. There were numerous distinct layers averaging 10 cm thick of different types of material including rocks, gravel, pieces of concrete, and metal. There was also a strong organic smell at the bottom of the trench. As with the first sampling trench the soil at this location to a depth of 1.3 m appears to have consisted entirely of fill material. The fill material however was distinctly different from the first site. Again, what could be considered native soil was not observed at this site.

The results of the chemical analysis for the seventeen inorganic elements are given in Tables 1,2 and 3. The elements are listed in alphabetical order. Also listed in each table are the Phytotoxicology Section Urban Upper Limit of Normal for each element where available and the Clean-Up Guidelines and Provisional Clean-Up guidelines for each element where available as listed the Ministry Publication "Guidelines for the Decommissioning and Cleanup of Sites in Ontario". Levels exceeding the Upper Limits of Normal (U.L.N.) have been indicated in bold type and levels exceeding the Decommissioning and Cleanup Guidelines (D.&C. G.) have been underlined.

Table 1 Results of Chemical Analysis for Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, and Cobalt in Soil from Two Location on Holmes Foundry Property, Collected May 10, 1989.

	Antimony µg/g	Arsenic µg/g	Barium µg/g	Beryllium µg/g	Cadmium µg/g	Chromium µg/g	Cobalt µg/g
B.H. 6							
0-5 cm	0.2	3.5	69	2.6	0.62	28	9.0
10-15 cm	0.2	4.1	67	2.7	0.49	30	10
25-30 cm	0.2	1.8	74	3.5	0.53	16	4.1
85-100 cm	0.2	1.7	71	4.1	0.14	15	4.0
TR 220							
0-5 cm	0.2	2.1	17	0.4	0.65	18	3.2
10-15 cm	1.8	4.4	71	1.1	**6.9**	**54**	7.5
25-30 cm	**20**	**20**	260	14	**60**	**230**	**28**
85-100 cm	2.2	4.9	65	3.3	2.2	30	7.3
120-130 cm	1.2	3.6	38	0.8	2.6	22	4.5
U.L.N	8	20			4	50	25
D.&C.G.	20^c	20	750^c	4^c	3	750	40

(^{c} - Provisional clean-up guidelines for soils.)

Table 2 Results of Chemical Analysis for Copper, Lead, Magnesium, Manganese, Mercury, Molybdenum and Nickel in Soil from Two Location on Holmes Foundry Property, Collected May 10, 1989.

	Copper µg/g	Lead µg/g	Magnesium µg/g	Manganese µg/g	Mercury µg/g	Molybdenum µg/g	Nickel µg/g
B.H. 6							
0-5 cm	27	26	14000	320	0.03	1.3	22
10-15 cm	54	25	17000	310	0.02	1.7	24
25-30 cm	22	37	5900	860	0.05	1.2	10
85-100 cm	15	13	6600	670	0.17	1.1	15
TR 220							
0-5 cm	33	43	2800	300	0.15	1.8	12
10-15 cm	**100**	440	21000	**2500**	1.2	5.3	27
25-30 cm	620	3400	27000	**14000**	13	23	110
85-100 cm	54	127	1700	490	1.5	2.4	27
120-130 cm	38	119	1700	520	**0.51**	2.0	18
U.L.N	100	500		700	0.5	3	60
D.&C.G.	150	375			0.8	5	150

([c] - Provisional clean-up guidelines for soils.)

Table 3 Results of Chemical Analysis for Nitrogen, Selenium, Silver, Sulphur, Vanadium, and Zinc in Soil from Two Location on Holmes Foundry Property, Collected May 10, 1989.

	Nitrogen mg/g	Selenium µg/g	Silver µg/g	Sulphur %	Vanadium µg/g	Zinc µg/g
B.H. 6						
0-5 cm	1.34	0.7	<0.1	0.030	35	87
10-15 cm	1.55	0.8	<0.1	0.033	38	79
25-30 cm	<0.20	0.5	<0.1	0.069	11	121
85-100 cm	0.23	0.8	<0.1	0.091	12	33
TR 220						
0-5 cm	0.29	0.3	0.1	0.021	5	117
10-15 cm	<0.19	0.9	<0.1	0.033	15	1450
25-30 cm	0.35	3.4	5.9	0.082	47	11900
85-100 cm	0.23	0.5	0.7	0.023	16	270
120-130 cm	<0.19	0.3	<0.1	0.129	10	257
U.L.N		2			70	500
D.&C.G.	0.5	2	20		200[c]	600

([c] - Provisional clean-up guidelines for soils.)

The results of the chemical analysis for the organic compounds are given in Tables 4 and 5. Tables 4 and 5 are the results for the extactable compounds. All results are expressed in ppb except for chloroform extractables which are expressed in ppm. All of the results for volatile organics (methylene chloride, trans-1,2-dichloroethylene, 1,1-dichloroethane, chloroform, 1,1,1-trichloroethane, benzene, carbon tetrachloride, bromodichloromethane, trichloroethylene, 1,2-dichloropropane, toluene, 1,1,2-trichloroethane, tetrachloroethylene, chlorodibromomethane, chlorobenzene, ethylbenzene, bromoform, m/p-xylene, 0-xylene, 1,1,2,2-tetrachlorethane, 1,4-dichlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, napthalene and medium boiling point petrolium distilate type materials) analysed for by headspace / capillary GC were below the detection limit except for traces of medium boiling point petrolium distilate type materials in surface soils at Bore Hole No.6 and 20 ppb benzene in the surface soil from the transformer room.

Table 4: Results of Chemical Analysis for PAHs, PCBs and Chloroform Extactable Compounds near Bore Hole No.6 and Transformer Atrium on Holmes Foundry Property, Collected May 10, 1989.

Test Parameter (ppb unless otherwise stated)	B.H. 6 0-5 cm	B.H. 6 10-15 cm	B.H. 6 25-30 cm	B.H. 6 85-100 cm	Transformer Atrium
pentachlorobenzene	nd	nd	nd	nd	nd
hexachlorobenzene	nd	nd	nd	nd	nd
octachlorostryrene	nd	nd	nd	nd	nd
napthalene	nd	nd	nd	nd	1300
2-methylnaphtalene	nd	nd	nd	nd	2700
1-methylnaphtalene	nd	nd	nd	nd	1300
phenanthrene	nd	nd	nd	200	1400
fluoranthene	nd	nd	nd	nd	1000
pyrene	nd	nd	nd	nd	840
benzo(a)anthracene	nd	nd	nd	nd	700
chrysene	nd	nd	nd	nd	490
perylene	nd	nd	nd	nd	160
benzo(k)fluoranthene	nd	nd	nd	nd	1000
benzo(a)pyrene	nd	nd	nd	nd	750
indeno(1,2,3-cd)pyrene	nd	nd	nd	nd	2400
dibnezp(a,h)anthracene	nd	nd	nd	nd	230
benzo(g,h,i)perylene	nd	nd	nd	nd	800
PCBs as Aroclor 1254	<20	<20	<20	<20	530
chloroform extractables (ppm)	500	360	320	380	11000

nd - not detected, detection limit of 100 ppb.

Table 5: Results of Chemical Analysis for PAHs, PCBs and Chloroform Extactable Compounds near Trench TR 220 on Holmes Foundry Property, Collected May 10, 1989.

Test Parameter (ppb unless otherwise stated)	TR 220 0-5 cm	TR 220 10-15 cm	TR 220 25-30 cm	TR 220 85-100 cm	TR 220 120-130cm
pentachlorobenzene	nd	nd	nd	nd	nd
hexachlorobenzene	nd	150	1200	190	nd
octachlorostryrene	nd	nd	110	nd	nd
napthalene	410	nd	nd	200	nd
2-methylnaphtalene	2200	nd	110	660	nd
1-methylnaphtalene	1600	nd	nd	440	nd
phenanthrene	160	nd	360	150	nd
fluoranthene	nd	160	870	nd	nd
pyrene	nd	140	670	100	nd
benzo(a)anthracene	nd	nd	390	nd	nd
chrysene	nd	nd	410	nd	nd
perylene	nd	nd	215	nd	nd
benzo(k)fluoranthene	nd	nd	1200	160	nd
benzo(a)pyrene	nd	nd	620	220	nd
indeno(1,2,3-cd)pyrene	nd	nd	4600	1400	nd
dibnezp(a,h)anthracene	nd	nd	340	100	nd
benzo(g,h,i)perylene	nd	nd	1800	660	nd
PCBs as Aroclor 1254	650	4500	7300	3200	640
chloroform extractables (ppm)	720	530	1300	720	530

nd - not detected, detection limit of 100 ppb.

4 Discussion

With the exception of elevated levels of nitrogen at 0-5 and 10-15 cm depths there were no exceedances of either the Urban Upper Limits of Normal or the Decommissioning and Cleanup Guidelines for the site near Bore Hole No. 6. This agrees with the results from the company. All of the organics tested for at this site, with the exception of phenanthrene, 200 ppb, at 85-100 cm, were below the analytical detection limits. The total solvent extractable levels were also low.

At site TR 220 there were a number of exceedances of both the Urban Upper Limits of Normal and the Decommissioning and Cleanup Guidelines. With the exception of mercury, all of the exceedances were limited to the 10-15 and 25-30 cm sampling depths. Exceedances occurred for antimony, arsenic, beryllium, cadmium chromium, cobalt, copper, lead, magnesium, mercury, molybdenum, nickel, selenium, and zinc. Exceedance of the D.&C. G. for mercury was also found at the 85-100 cm depth at this location.

The levels of organic compounds at TR 220 were also elevated. Both PAHs and PCB were elevated, with the highest levels occuring at 35 cm. There were no detectable PAHs and only slightly elevated PCBs at the 120-130 cm depth. Total solvent extractable levels were also elevated in a similar pattern to the PAHs and PCBs.

The planned excavation of the soil at TR 220 to a depth of one meter should remove virtually all of the contaminated soil at that location. Only some of the low level organics may be left below one meter.

The surface soil from the transformer atrium was also contaminated with organics. Elevated levels of PAHs similar to the 35 cm depth near TR 220 were found. Levels of PCBs were only slightly elevated and were lower than the TR 220 area. The total solvent extractables were also high, approximately 8 times higher than the highest levels at site TR 220.

5 Summary

The results from the two sampling trenches and the surface sample from the transformer atrium sampled by the MOE were similar to the consultant's results. There were some minor differences but this can be expected considering the disturbed conditions of the soil at this site. There was no indication that soil removal other than what had been recommended for the three areas sampled was required.

6 Appendices

6.1 Derivation and Significance of MOE "Upper Limits of Normal" Contaminant Guidelines

The MOE "upper limits of normal" contaminant guidelines essentially represent the expected maximum concentration of contaminants in surface soil (non-agricultural), foliage (tree and shrub), grass, moss bags and or snow from areas of Ontario not subject to the influence of point sources of emissions. "Urban" guidelines are based upon samples collected from centers of minimum 10,000 population. "Rural" guidelines are based upon samples collected from non-built-up areas. Samples were collected by MOE personnel using standard sampling techniques (ref: Ministry of the Environment, 1983. Field Investigation Manual. Phytotoxicology Section - Air Resources Branch: Technical Support Sections - NE and NW Regions). Chemical analyses were performed by the MOE Laboratory Services Branch.

The guidelines were calculated by taking the arithmetic mean of available analytical data and adding three standard deviations of the mean. For those distributions that are "normal", 99% of all contaminant levels in samples from "background" locations (i.e. not affected by point sources nor agricultural activities) will lie below these upper limits of normal. For those distributions that are non-normal, the calculated upper limits of normal will not actually equal the 99th percentile, but nevertheless they lie within the observed upper range of MOE results for Ontario samples.

Due to the large variability in element concentrations which may be present across Ontario, even in background data, control samples should always be collected. This is particularly important for soils, which may show large regional variations in element composition due to difference in parent material. Species of vegetation which naturally accumulate high levels of an element also may be encountered.

It is stressed that these guidelines do not represent maximum desirable or allowable levels of contaminants. Rather, they serve as levels which, if exceeded, would prompt further investigation on a case by case basis to determine the significance, if any, of the above normal concentration(s). Concentrations which exceed the guidelines are not necessarily toxic to plants, animals or man. Concentrations which are below the guidelines are not known to be toxic.

6.2 References

1. Guidelines for the Decommissioning and Cleanup of Sites in Ontario, Ontario Ministry of Environment, Waste Management Branch, ISBN: 0-7729-5278-7, February 1989
2. Ontario Ministry of the Environment "Upper Limit of Normal" Contaminant Guidelines for Phytotoxicology Samples, Phytotoxicology Section, Air Resources Branch, ARB-138-88-Phyto, ISBN: 0-7729-5143-8, March 1989